NASA/GSFC	NETWORKS AND MISSION SERVICES PROJECTS (N&MSP) CONFIGURATION CHANGE REQUEST (CCR)

1. CCR. NO.	2. DATE	3. PRIORITY	4. CHANGE LEVEL
CCR-451-WSC-08	May 26, 1999	☐ EMERGENCY ☐ URGENT ☒ ROUTINE	☐ A ☒ B ☐ C

5. TITLE OF CHANGE: Replacement of "STDN 108" References with "451-PN Code-SNIP" References

6. DOCUMENT TITLE: Requirements Specification for the White Sands Complex, Revision 1, June 1, 1997

DOCUMENT NO.: 530-RSD-WSC, Rev. 1

LIST ALL AFFECTED DOCUMENTS INCLUDING PROCEDURES:

7. REASON FOR CHANGE:

To replace all references of "STDN 108" with its superseding document, "451-PN Code-SNIP"

8. DESCRIPTION OF CHANGE: Pages 2-2, 5-44, 5-45, 5-52, 5-58, 5-59, 5-80, 5-81, 5-101, 5-102, 5-127

9. IMPACT

SYSTEM

Y	N		Y	N		Y	N	
☐	☒	SCHEDULE	☐	☒	BUDGET	☐	☒	FACILITIES
☐	☒	TESTING	☐	☒	TRAINING	☐	☒	CONTRACTOR SUPPORT
☐	☒	INTERFACES	☐	☒	SECURITY	☐	☒	HARDWARE
☒	☐	SOFTWARE	☐	☒	LOGISTICS	☒	☐	DOCUMENTATION
☒	☐	GROUND SEGMENT				☐	☒	SPACE SEGMENT
☐	☒	OTHER _____						

ORGANIZATIONAL

Y	N		Y	N		Y	N	
☐	☒	450	☐	☒	____	☐	☒	MSFC
☒	☐	451	☐	☒	____	☐	☒	JSC
☐	☒	452	☐	☒	____	☐	☒	LERC
☐	☒	453	☒	☐	Code 405	☐	☒	KSC
						☐	☒	JPL

10. COMMENTS:

This CCR is available for review at http://stelwscpo.gsfc.nasa.gov/

11. ORIGINATOR D. Gilliland 301-809-2205 **CODE 451**

SIGNATURE _____ **DATE** _____

12. SEGMENT MANAGERS APPROVAL **CODE** _____

SIGNATURE _____ **DATE** _____

13. BOARD CHAIRPERSON SIGNATURE **DATE**

14. BOARD CHAIRPERSON COMMENTS

15. BOARD ACTION

☐ Approved ☐ Withdrawn
☐ Disapproved ☐ Deferred

_____

16. ACTION REQUIRED

☐ Publish Document ☐ Publish DCN
☐ Deviation ☐ Waiver
☐ Implement Change ☐ Other _____

Document Number	Document Title
534-OIP-NCC/STGT	Operations Interface Procedures between the Goddard Space Flight Center Network Control Center and the Second TDRSS Ground Terminal
DOD-STD-2167	Defense System Software Development
DOD-STD-2167, STGT Tailored Version	Defense System Software Development, STGT Tailored Version
GA-GEM-1331331	Contractor Administered Training Course, Sections 6, 9, 12
GHB 1600.1A	Goddard Space Flight Center Security Manual
GSFC FDF/552-89/001	Mathematical Theory of the Goddard Trajectory Determination System, Sections 3.2.2, 3.3, 3.4.3, and 3.4.7.
ICD-2-0D004	JSC/GSFC Space Shuttle RF Communications and Tracking, Sections 4.2.1, 4.2.2, 4.2.4, 4.2.6, 4.2.7, and 4.2.8.1
NHB 1620.3A	NASA Security Handbook
NHB 2410.9A	NASA Automated Information Security Handbook
S-323-P-5A	Quality Assurance Requirements for Standard Industrial Equipment
S-530-1	GSFC Specification for Ground System Spare Parts Program
S-572-P-3B	Engineering Drawing Standards and Specifications
SN SCG	Space Network Security Classification Guide
STDN 102	STDN Documentation System
STDN 102.1	Standard for Preparation of STDN Operations Documents
STDN 102.8	Handbook for Interface Control Documents for Non-Project Related Ground Facilities
~~STDN 108~~451-PN CODE-SNIP	~~PN Codes for Use with the Tracking and Data Relay Satellite System (TDRSS)~~Space Network Interoperable PN Code Libraries

Table 5-9. SSAF Service Signal Parameters

A. RATIO OF COMMAND CHANNEL POWER TO RANGE CHANNEL POWER	10 dB
B. RANGE CHANNEL	
1. CARRIER FREQUENCY	COMMAND CHANNEL CARRIER FREQUENCY DELAYED $\pi/2$ RADIANS
2. PN MODULATION	PSK, $\pm \pi/2$ RADIANS
3. CARRIER SUPPRESSION	30 dB MINIMUM
4. PN CHIP RATE	$\frac{31}{221 \times 96} \times K_F$ SYNCHRONOUS WITH COMMAND CHANNEL PN CODE CHIP RATE ($\approx$ 3M CHIPS/SEC)
5. PN CODE LENGTH	$(2^{10}-1) \times 256$ CHIPS
6. PN CODE EPOCH REFERENCE	PN CODE EPOCH (ALL 1'S CONDITION) SYNCHRONIZED TO THE COMMAND CHANNEL PN CODE EPOCH
7. PN CODE FAMILY	TRUNCATED 18-STATE SHIFT REGISTER SEQUENCES; PER ~~STDN NO.108~~451-PN CODE-SNIP
C. COMMAND CHANNEL	
1. CARRIER FREQUENCY	SGLT TRANSMIT CARRIER FREQUENCY
2. PN MODULATION	PSK, $\pm \pi/2$ RADIANS
3. CARRIER SUPPRESSION	30 dB MINIMUM
4. PN CODE LENGTH	$2^{10}-1$ CHIPS
5. PN CODE FAMILY	GOLD CODES; PER ~~STDN NO.108~~451-PN CODE-SNIP
6. PN CHIP RATE[1] (CHIPS/SEC)	$\frac{31}{221 \times 96} \times K_F$ ($\approx$ 3M CHIPS/SEC)
7. DATA FORMAT	NRZ-L, NRZ-M, NRZ-S
8. DATA RATE[2]	0.1 TO 300 kbps
9. DATA MODULATION	MODULO-2 ADDED ASYNCHRONOUSLY TO PN CODE

NOTES

[1] K_F IS THE TDRS-TO-CUSTOMER FREQUENCY.

$$2200 \text{ MHz} \left(\frac{221}{240}\right) \leq K_F \leq 2300 \text{ MHz} \left(\frac{221}{240}\right)$$

[2] THE SSAF SERVICE CHAIN SHALL BE CAPABLE OF ACCOMMODATING ANY CHANGE TO THE ACTUAL INPUT DATA RATE WITHOUT THE SGLT BEING NOTIFIED OF THE CHANGE BY THE NCC.

Table 5-10. SSHF Service Signal Parameters

A. DATA RATE	MODE 1: 32 kbps; MODE 2: 72 kbps
B. CONVOLUTIONAL CODING	NRZ-L INPUT DATA SHALL BE CONVOLUTIONALLY ENCODED IN MODES 1 & 2
C. CODE RATE	1/3
D. CONSTRAINT LENGTH	7
E. GENERATOR FUNCTIONS	G_1: 1111001; G_2: 1011011; G_3: 1100101
F. DATA FORMAT	ENCODED DATA SHALL BE CONVERTED TO BIPHASE-L FORMAT
G. DATA MODULATION[1]	BIPHASE-L SYMBOLS SHALL BE MODULO-2 ADDED ASYNCHRONOUSLY TO PN CODE
H. PN CHIP RATE[2]	11.232 MCHIPS PER SECOND, TUNABLE OVER ± 0.1%
I. PN CODE LENGTH	1023 CHIPS
J. CARRIER MODULATION	PSK, ± π /2 RADIANS
K. CARRIER SUPPRESSION	30 dB, MINIMUM
L. PN CODE FAMILY	PER ~~STDN 108~~451-PN CODE-SNIP

NOTES

[1]WHEN THE DATA CLOCK SIGNAL IS CLAMPED TO A LOGICAL-1 STATE, THE CARRIER SHALL CONTAIN NO DATA MODULATION. WHEN THE COMMAND CHANNEL PN MODULATION IS INHIBITED THE DATA SHALL DIRECTLY BPSK MODULATE THE TRANSMITTED CARRIER ±π /2 RADIANS.

[2]SHUTTLE PN CHIP RATE AND CARRIER FREQUENCY ARE INDEPENDENT. PN CHIP RATE AND CARRIER FREQUENCY SHALL BE AS SCHEDULED. CAPABILITY TO INDEPENDENTLY DOPPLER COMPENSATE THE PN CHIP RATE AND CARRIER FREQUENCY AND TO INDEPENDENTLY INHIBIT DOPPLER COMPENSATION SHALL BE PROVIDED.

Table 5-11. Signal Constraint Requirements for SSAF Service Equipment[1]

PARAMETER	REQUIREMENT
A. COMMAND CHANNEL RADIATED POWER RANGE CHANNEL RADIATED POWER	10 ± 0.5 dB
B. MODULATOR GAIN IMBALANCE (PEAK)	± 0.25 dB
C. RELATIVE PHASE BETWEEN COMMAND AND RANGE CHANNELS (PEAK)	90 ± 3°
D. DATA ASYMMETRY (PEAK)[2]	± 3%
E. DATA TRANSITION TIME (90% OF INITIAL STATE TO 90% OF FINAL STATE)[2]	≤ 5% OF DATA BIT DURATION
F. PHASE NONLINEARITY (PEAK), BEST STRAIGHT LINE (BSL)	± 4.25° OVER ± 7.0 MHz
G. GAIN FLATNESS (PEAK), RSS	± 0.4 dB OVER ± 7.0 MHz
H. GAIN SLOPE (PEAK)	± 0.1 dB/MHz OVER ± 7.0 MHz

Table 5-16. KSAF Service Signal Parameters (Continued)

6. PN CODE EPOCH REFERENCE	ALL 1'S CONDITION SYNCHRONIZED TO THE COMMAND CHANNEL PN CODE EPOCH
7. PN CODE FAMILY	TRUNCATED 18-STAGE SHIFT REGISTER SEQUENCES; PER ~~STDN No. 108~~451-PN CODE-SNIP
C. COMMAND CHANNEL	
1. CARRIER FREQUENCY	SGLT TRANSMIT CARRIER FREQUENCY
2. PN MODULATION[2]	PSK, ± π /2 RADIANS
3. CARRIER SUPPRESSION	30 dB MINIMUM
4. PN CODE LENGTH	2^{10}-1 CHIPS
5. PN CODE FAMILY	GOLD CODES; PER ~~STDN No. 108~~451-PN CODE-SNIP
6. PN CHIP RATE[3] (CHIPS/SEC)	$\frac{31}{1469 \times 96} \times K_F$ (≈ 3M CHIPS/SEC)
7. DATA FORMAT	NRZ-L, NRZ-M, NRZ-S
8. DATA RATE[5]	1 kbps TO 25 Mbps
9. DATA MODULATION	MODULO-2 ADDED ASYNCHRONOUSLY TO PN CODE

NOTES

[1]FOR DATA RATES > 300 kbps, THE RANGE CHANNEL SHALL BE INHIBITED.

[2]THE COMMAND CHANNEL PN MODULATION SHALL BE INHIBITED FOR DATA RATES EXCEEDING 300 kbps.

[3]K_F IS THE TDRS TO CUSTOMER FREQUENCY. K_F = 13.775 ± 0.7 MHz.

[4]WHEN THE DATA CLOCK SIGNAL IS CLAMPED TO A LOGICAL-1 STATE, THE CARRIER SHALL CONTAIN NO DATA MODULATION. WHEN THE COMMAND CHANNEL PN MODULATION IS INHIBITED THE DATA SHALL DIRECTLY BPSK MODULATE THE TRANSMITTED CARRIER ± π /2 RADIANS.

[5]FOR DATA RATES LESS THAN 300 kbps, THE KSAF SERVICE CHAIN SHALL BE CAPABLE OF ACCOMMODATING ANY CHANGE TO THE ACTUAL INPUT DATA RATE WITHOUT THE SGLT BEING NOTIFIED OF THE CHANGE BY THE NCC.

Table 5-17. KSHF Service Signal Parameters

A. PN MODULATION[2]	PSK, ± π /2 RADIANS
B. CARRIER SUPPRESSION	30 dB MINIMUM
C. PN CODE LENGTH	2^{10} -1 CHIPS
D. PN CODE FAMILY	GOLD CODES; PER ~~STDN No. 108~~451-PN CODE-SNIP

(a) Clock Presence.

(b) Data Transition Density.

b. Format Panel Capabilities. To support the MTG requirements, all equipment, down to the LRU level, shall incorporate front panel controls, status indicators, and test and monitoring points that include:

1. Visual on/off status indication.
2. Visual prime-redundant status indication.
3. Access to input/output baseband, IF and RF signals and selected voltage levels.
4. All status provided to the USS ADPE Subsystem.
5. ON/OFF Controls.
6. Test mode selects.

c. BIT/BITE Monitoring. Provide BIT/BITE monitoring data to the USS ADPE Subsystem.

5.3.1.3.3 MAF Equipment

The performance of the MAF equipment shall be as specified below.

5.3.1.3.3.1 Signal Parameters

The MAF service chain shall provide a signal with parameters as specified in Table 5-23.

Table 5-23. MAF Service Signal Parameters

A. RATIO OF COMMAND CHANNEL POWER TO RANGE CHANNEL POWER	10 dB
B. RANGE CHANNEL	
1. CARRIER FREQUENCY	COMMAND CHANNEL CARRIER FREQUENCY DELAYED $\pi/2$ RADIANS
2. PN MODULATION	PSK, $\pm \pi/2$ RADIANS
3. CARRIER SUPPRESSION	30 dB MINIMUM
4. PN CHIP RATE	$\frac{31}{221x96} \times K_F$ ($\approx$ 3M CHIPS/SEC) SYNCHRONOUS WITH COMMAND CHANNEL PN CODE CHIP RATE
5. PN CODE LENGTH	$(2^{10}-1) \times 256$ CHIPS
6. PN CODE EPOCH REFERENCE	PN CODE EPOCH (ALL 1'S CONDITION) SYNCHRONIZED TO THE COMMAND CHANNEL PN CODE EPOCH
7. PN CODE FAMILY	TRUNCATED 18-STAGE SHIFT REGISTER SEQUENCES; PER ~~STDN 108~~451-PN CODE-SNIP

Table 5-23. MAF Service Signal Parameters (Continued)

C. COMMAND CHANNEL	
1. CARRIER FREQUENCY	SGLT TRANSMIT CARRIER FREQUENCY
2. PN MODULATION	PSK, ± π/2 RADIANS
3. CARRIER SUPPRESSION	30 dB MINIMUM
4. PN CODE LENGTH	2^{10} -1 CHIPS
5. PN CODE FAMILY	GOLD CODES; PER 451-PN CODE-SNIP~~STDN 108~~
6. PN CHIP RATE[1] (CHIPS/SEC)	$\frac{31}{221x96}$ x K_F (≈ 3M CHIPS/SEC)
7. DATA FORMAT	NRZ-L, NRZ-M, NRZ-S
8. DATA RATE[2]	0.1 TO 10 kbps
9. DATA MODULATION	MODULO-2 ADDED ASYNCHRONOUSLY TO PN CODE

NOTES

[1] K_F IS THE TDRS-TO-CUSTOMER FREQUENCY. $K_F = 2287.5 \pm 0.1$ MHz $\left(\frac{221}{240}\right)$

[2] THE MAF SERVICE CHAIN SHALL BE CAPABLE OF ACCOMMODATING ANY CHANGE TO THE ACTUAL INPUT DATA RATE WITHOUT THE SGLT BEING NOTIFIED OF THE CHANGE BY THE NCC.

5.3.1.3.3.2 Forward Signal Constraints

The MAF service chain shall provide a MAF signal which meets the signal constraint requirements of Table 5-24; these characteristics are defined at the output of the USS.

Table 5-24. Signal Constraint Requirements for MAF Service Equipment[1]

PARAMETER	REQUIREMENT
A. COMMAND CHANNEL RADIATED POWER RANGE CHANNEL RADIATED POWER	10 ± 0.5 dB
B. MODULATOR GAIN IMBALANCE (PEAK)	± 0.25 dB
C. RELATIVE PHASE BETWEEN COMMAND AND RANGE CHANNELS (PEAK)	90 ± 3°
D. DATA ASYMMETRY (PEAK)[2]	± 3%
E. DATA TRANSITION TIME (90% OF INITIAL STATE TO 90% OF FINAL STATE)[2]	≤ 5% OF DATA BIT DURATION
F. PHASE NONLINEARITY (PEAK), BEST STRAIGHT LINE (BSL)	± 4.25° OVER ± 2.1 MHz

Table 5-29. SSAR Service Signal Parameters

A. DATA GROUP 1 (DG1)[1]	
1. CUSTOMER CARRIER FREQUENCY (F_1)[2] MODES 1 AND 3 MODE 2[8]	$\frac{240}{221} \times F_R$ CUSTOMER SPACECRAFT OSCILLATOR
2. PN CODE MODULATION MODES 1 AND 2 MODE 3, I CHANNEL	 SQPN PSK, ± π /2 RADIANS
3. PN CHIP RATE (CHIPS/SEC)	$\frac{31}{240 \times 96} \times F_1$ (≈ 3M CHIPS/SEC)
4. PN CODE LENGTH (CHIPS) MODES 1 AND 3 MODE 2	 $(2^{10} - 1) \times 256$ $2^{11} - 1$
5. PN CODE EPOCH REFERENCE MODE 1 I CHANNEL Q CHANNEL[3] MODE 2 I CHANNEL Q CHANNEL MODE 3, I CHANNEL	 EPOCH (ALL 1'S CONDITION) SYNCHRONIZED TO EPOCH (ALL 1'S CONDITION) OF CUSTOMER SPACECRAFT RECEIVED FORWARD SERVICE RANGE CHANNEL PN CODE EPOCH DELAYED X + 1/2 PN CHIPS RELATIVE TO I CHANNEL PN CODE EPOCH CUSTOMER SPACECRAFT OSCILLATOR EPOCH DELAYED 1/2 PN CODE CHIP PERIOD RELATIVE TO I CHANNEL PN CODE EPOCH SAME AS MODE 1 (I CHANNEL)
6. PN CODE FAMILY MODES 1 AND 3 MODE 2	 TRUNCATED 18 STAGE SHIFT REGISTER SEQUENCES; PER 451-PN CODE-SNIP~~STDN 108~~ GOLD CODES; PER 451-PN CODE-SNIP~~STDN 108~~
7. SYMBOL INTERLEAVING[4]	530-SNUG (APPENDIX F)
8. SYMBOL FORMAT[7]	NRZ, Bi ϕ -L
9. DATA FORMAT	NRZ-L, NRZ-M, NRZ-S
10. DATA MODULATION MODES 1 AND 2 MODE 3 I CHANNEL Q CHANNEL	 MODULO-2 ADDED ASYNCHRONOUSLY TO PN CODE ON EACH CHANNEL; SQPN MODULO-2 ADDED ASYNCHRONOUSLY TO PN CODE PSK ± π /2 RADIANS

Table 5-29. SSAR Service Signal Parameters (Continued)

11. MODE 1 DATA RATE RESTRICTIONS[5] TOTAL I CHANNEL Q CHANNEL	 0.1-300 kbps 0.1-150 kbps 0.1-150 kbps
12. MODE 2 DATA RATE RESTRICTIONS[5] TOTAL I CHANNEL Q CHANNEL	 1-300 kbps 1-150 kbps 1-150 kbps
13. MODE 3 DATA RATE RESTRICTIONS[5] TOTAL I CHANNEL Q CHANNEL	 I (MAX) + Q (MAX) 0.1-150 kbps 1 kbps - 3 Mbps
B. DATA GROUP 2[1]	
1. CUSTOMER CARRIER FREQUENCY (F_2) COHERENT MODE (MODE 1)	$\frac{240}{221} \times F_R$
NONCOHERENT MODE (MODE 2)[8]	CUSTOMER SPACECRAFT OSCILLATOR
2. SYMBOL FORMAT[7]	NRZ, Biϕ– L
3. DATA FORMAT	NRZ-L, NRZ-M, NRZ-S
4. DATA RATE RESTRICTIONS[5,6] TOTAL I CHANNEL Q CHANNEL	 I (MAX) + Q(MAX) 1 kbps - 3 Mbps 1 kbps - 3 Mbps
5. DATA MODULATION	SQPSK, BPSK (SINGLE DATA CHANNEL), OR QPSK (DUAL DATA CHANNEL)
6. SYMBOL INTERLEAVING[4]	530-SNUG (APPENDIX F)

NOTES

[1]THE CUSTOMER SPACECRAFT DATA CONFIGURATIONS ARE DEFINED IN SECTION 5.3.2.3.1.3.

[2]F_R IS THE CARRIER FREQUENCY ARRIVING AT THE CUSTOMER SPACECRAFT; EXCEPT DURING SCHEDULED PERIODS OF DOPPLER COMPENSATION INHIBIT, $F_R = f_0 \pm E$, WHERE f_0 EQUALS THE NOMINAL CENTER FREQUENCY OF THE CUSTOMER SPACECRAFT RECEIVER AS DEFINED IN THE SCHEDULE AND $E = 70 \times \ddot{R}$ WHERE $\ddot{R} \leq 50$ m/sec^2.

[3]Q CHANNEL PN CODE IS IDENTICAL TO I CHANNEL PN CODE OFFSET x + 1/2 PN CHIPS, WHERE $x \geq 20{,}000$. VALUE OF x IS DETERMINED BY PN CODE ASSIGNMENTS FOR A PARTICULAR CUSTOMER SPACECRAFT (451-PN CODE-SNIP~~STDN 108~~).

[4]FOR DG1, SYMBOL INTERLEAVING SHALL BE APPLICABLE ONLY TO THE DG1 MODE 3 Q CHANNEL. SYMBOL INTERLEAVING SHALL BE APPLICABLE ONLY FOR SYMBOL RATES EXCEEDING 300 ksps.

Table 5-39. KSAR Service Signal Parameters (Continued)

Q CHANNEL[3]	EPOCH DELAYED X + 1/2 PN CHIPS RELATIVE TO I CHANNEL PN CODE EPOCH
MODE 2	CUSTOMER SPACECRAFT TRANSMITTER OSCILLATOR
I CHANNEL Q CHANNEL	EPOCH DELAYED 1/2 PN CODE CHIP PERIOD RELATIVE TO I CHANNEL PN CODE EPOCH
MODE 3 I CHANNEL	SAME AS MODE 1 (I CHANNEL)
6. PN CODE FAMILY MODES 1 AND 3	TRUNCATED 18 STAGE SHIFT REGISTER SEQUENCES; PER ~~STDN NO. 108~~451-PN CODE-SNIP
MODE 2	GOLD CODES; PER ~~STDN NO. 108~~451-PN CODE-SNIP
7. DATA FORMAT WITHOUT CONVOLUTIONAL CODING	NRZ-L, NRZ-M, NRZ-S, Biϕ-L, Biϕ-M, Biϕ-S
WITH CONVOLUTIONAL CODING[4]	NRZ-L, NRZ-M, NRZ-S
8. DATA MODULATION MODES 1 AND 2	MODULO-2 ADDED ASYNCHRONOUSLY TO PN CODE ON EACH CHANNEL; SQPN
MODE 3 I CHANNEL	MODULO-2 ADDED ASYNCHRONOUSLY TO PN CODE
Q CHANNEL	PSK ± π /2 RADIANS
9. MODE 1 DATA RATE RESTRICTIONS[5] TOTAL I CHANNEL Q CHANNEL	1-600 kbps 1-300 kbps 1-300 kbps
10. MODE 2 DATA RATE RESTRICTIONS[5] TOTAL I CHANNEL Q CHANNEL	1-600 kbps 1-300 kbps 1-300 kbps
11. MODE 3 DATA RATE RESTRICTIONS[5] TOTAL I CHANNEL Q CHANNEL	I(MAX) + Q(MAX) 1-300 kbps 1 kbps - 150 Mbps

Table 5-39. KSAR Service Signal Parameters (Continued)

B. DATA GROUP 2[1]	
1. CUSTOMER CARRIER FREQUENCY (F_2)	$\frac{1600}{1469} \times F_R$
COHERENT MODE (MODE 1)	CUSTOMER SPACECRAFT OSCILLATOR
NONCOHERENT MODE (MODE 2)[8]	
2. DATA FORMAT	
WITHOUT CONVOLUTIONAL CODING[6]	NRZ-L, NRZ-M, NRZ-S, Biϕ-L, Biϕ-M, Biϕ-S
WITH CONVOLUTIONAL CODING[4]	NRZ-L, NRZ-M, NRZ-S
3. DATA RATE RESTRICTIONS[5]	
TOTAL	1 kbps - 300 Mbps
I CHANNEL	1 kbps - 150 Mbps
Q CHANNEL	1 kbps - 150 Mbps
4. DATA MODULATION[7]	SQPSK, BPSK (SINGLE DATA CHANNEL), OR QPSK (DUAL DATA CHANNEL)

NOTES

[1]THE CUSTOMER SPACECRAFT DATA CONFIGURATION ARE DEFINED IN SECTION 5.3.2.3.2.3.

[2]F_R IS THE CARRIER FREQUENCY ARRIVING AT THE CUSTOMER SPACECRAFT; EXCEPT DURING SCHEDULED PERIODS OF DOPPLER COMPENSATION INHIBIT, $F_R = f_o \pm E$, WHERE f_o EQUALS THE NOMINAL CENTER FREQUENCY OF THE CUSTOMER SPACECRAFT RECEIVER AS DEFINED IN THE SCHEDULE AND $E = 500 \times \ddot{R}$ WHERE $\ddot{R} \leq 15 m/SEC^2$.

[3]Q CHANNEL PN CODE IS IDENTICAL TO I CHANNEL PN CODE OFFSET x + 1/2 PN CHIPS, WHERE $x \geq 20{,}000$. VALUE OF x IS DETERMINED BY PN CODE ASSIGNMENTS FOR A PARTICULAR CUSTOMER SPACECRAFT (~~STDN NO. 108~~451-PN CODE-SNIP).

[4]AT THE OPTION OF THE CUSTOMER, THE OUTPUT OF THE CONVOLUTIONAL ENCODER MAY BE NRZ TO Biϕ-L CONVERTED. THIS FORMAT CONVERSION CAPABILITY WILL ONLY BE UTILIZED WITH DATA RATES $\leq$ 5 Mbps. NO G_2 SYMBOL INVERSIONS WITHIN THE CONVOLUTIONAL ENCODER WILL OCCUR WHEN THE OUTPUT OF THE CONVOLUTIONAL ENCODER IS CONVERTED TO Biϕ-L FORMAT.

[5]DATA SIGNALS ON I AND Q CHANNELS MAY BE INDEPENDENT AND ASYNCHRONOUS. IF THE I AND Q CHANNEL DATA SIGNALS ARE INDEPENDENT, THE SUM OF THE DATA RATES ON THE I AND Q CHANNEL SHALL NOT EXCEED THE TOTAL MAXIMUM DATA RATE. FOR DATA GROUP 2 DUAL CHANNEL WITH IDENTICAL SYMBOL RATES ON THE I AND Q CHANNELS, THE I AND Q CHANNELS WILL BE OFFSET RELATIVE TO ONE ANOTHER BY ONE-HALF DATA BIT PERIOD OR, IF CONVOLUTIONALLY CODED, ONE-HALF ENCODED DATA SYMBOL PERIOD. FOR DG1 AND DG2, MAXIMUM DATA RATES FOR THE I CHANNEL, THE Q CHANNEL, AND THE TOTAL ARE REDUCED BY A FACTOR OF 2 WHEN DATA IS EITHER Bi-ϕ FORMATTED OR RATE ONE-HALF CONVOLUTIONALLY CODED. WHEN RATE ONE-HALF CONVOLUTIONAL CODING AND Bi-ϕ FORMAT CONVERSION ARE USED, THE MAXIMUM DATA RATES FOR THE I CHANNEL, THE Q CHANNEL, AND THE TOTAL ARE REDUCED BY A FACTOR OF 4 FOR DG1 AND DG2. Bi-ϕ DATA FORMAT WILL NOT BE USED FOR DATA RATES EXCEEDING 5 Mbps.

Table 5-47. MAR Service Signal Parameters (Cont'd)

6. PN CODE FAMILY	
MODE 1	TRUNCATED 18 STAGE SHIFT REGISTER SEQUENCES; PER ~~STDN 108~~451-PN Code-SNIP
MODE 2	GOLD CODES; PER 451-PN Code-SNIP~~STDN 108~~
7. SYMBOL FORMAT[4]	NRZ, Biϕ-L
8. DATA FORMAT	NRZ-L, NRZ-M, NRZ-S
9. DATA MODULATION	
MODES 1 AND 2	MODULO-2 ADDED ASYNCHRONOUSLY TO PN CODE ON EACH CHANNEL; SQPN
10. MODE 1 DATA RATE RESTRICTIONS[5]	
TOTAL I CHANNEL Q CHANNEL	0.1 - 100 kbps 0.1 - 100 kbps 0.1 - 100 kbps
11. MODE 2 DATA RATE RESTRICTIONS[5]	
TOTAL I CHANNEL Q CHANNEL	1 - 100 kbps 1 - 100 kbps 1 - 100 kbps

NOTES

[1]THE CUSTOMER SPACECRAFT DATA CONFIGURATIONS ARE DEFINED IN SECTION 5.3.2.3.3.3.

[2]F_R IS THE CARRIER FREQUENCY ARRIVING AT THE CUSTOMER SPACECRAFT; EXCEPT DURING SCHEDULED PERIODS OF DOPPLER COMPENSATION INHIBIT, $F_R = f_o \pm E$, WHERE f_o EQUALS THE NOMINAL CENTER FREQUENCY OF THE CUSTOMER SPACECRAFT RECEIVER AS DEFINED IN THE SCHEDULE AND $E = 70 \times \ddot{R}$ WHERE $\ddot{R} \leq 15$ m/SEC^2

[3]Q CHANNEL PN CODE IS IDENTICAL TO I CHANNEL PN CODE OFFSET x + 1/2 PN CHIPS, WHERE $x \geq 20{,}000$. VALUE OF x IS DETERMINED BY PN CODE ASSIGNMENTS FOR A PARTICULAR CUSTOMER SPACECRAFT (451-PN CODE-SNIP~~STDN 108~~).

[4]IF THE TRANSMITTED SYMBOL FORMAT IS NRZ-TO-Biϕ-L CONVERTED, THERE WILL BE NO G_2 INVERSION.

[5]DATA SIGNALS ON THE I AND Q CHANNELS MAY BE INDEPENDENT AND ASYNCHRONOUS. IF THE I AND Q CHANNEL DATA SIGNALS ARE INDEPENDENT, THE SUM OF THE DATA RATES ON THE I AND Q CHANNEL MUST NOT EXCEED 100 kb/SEC. IF THE I AND Q CHANNEL DATA SIGNALS ARE IDENTICAL AND SYNCHRONOUS (I.E., SINGLE DATA CHANNEL OPERATIONS), THE CHANNEL DATA RATE MUST NOT EXCEED 100 kb/SEC.

[6]MODE 2A DENOTES MODE 2 WHEN THE CUSTOMER SPACECRAFT OSCILLATOR FREQUENCY UNCERTAINTY IS LESS THAN ± 700 Hz; MODE 2B DENOTES THE CASE WHEN THE UNCERTAINTY IS LESS THAN ± 3 kHz.